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Final Report for ONR Grant N00014-92-J-1763

"Density Structure of the Upper Oceanic Crust at Zero Porosity"

As part of this research project, we obtained data on the density of about forty samples of submarine mid-ocean ridge basalt (MORB). These data were obtained using a pychnometer after careful hand-picking of glass shards and have a precision better than ± 0.05 g/cm³. A very surprising result is that the measured densities have a much greater range (2.7-2.95 gm/cm³) than expected densities calculated from their chemical composition (2.85-2.97). While we cannot yet rule out the effects of volatiles (H₂O and CO₂), micro cracks and slight alteration of glasses, we hope to be able to do so soon.

A much more likely explanation is that the glass density variations are due to differences in cooling history, with the melts having crossed the glass transition under different conditions. It is thus possible that glass density records critical information about cooling rate. If so, this could be used as a powerful tool for evaluating melt-seawater interactions during submarine eruptions and eruption dynamics of submarine eruptions. This is important because since such eruptions have not been witnessed as they occur, little is known about how they progress.

In collaboration with Dr. Don Dingwell and his students at the University of Beyreuth (Germany), we are actively pursing this question. We will measure the heat capacities and glass transition properties of these glasses to determine how cooling rate affects glass density and other second-order thermodynamic properties. The results will be published as soon as possible after we understand the causes of the observed density differences and how glass density can be used to further our understanding of the origin of ocean crust.

In parallel, we are working with Dr. N. Christensen at Purdue University to obtain seismic velocity data for pure basalt glasses. This has proved to be very challenging, but we expect results within a year or so. A-I

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August 25, 1994

Defense Technical Information Center Building 5, Cameron Station Alexandria, VA 22314

Dear Sir/Madam,

Enclosed please find the Final Report for N00014-92-J-1763.

Thank you.

Sincerely,

Rodey Batiza Professor

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